STATUS AND NUMERICAL FLUCTUATIONS OF SOME NORTH AMERICAN WADERS ALONG THE SURINAM COAST

ARIE L. SPAANS

Throughout the year, the muddy coast of Surinam (South America) forms a favorite haunt for large numbers of North American shorebirds (Haverschmidt 1955, 1968). This paper deals with the status, numerical fluctuations, and habitat selection of species that visit the Surinam coast regularly. Data were gathered from April 1970 through May 1973.

STUDY AREA AND METHODS

Study area.—The Surinam coast is situated on the northeastern fringe of South America at about 6° N latitude and between 54° and 57° W longitude (Fig. 1). Geographically, it forms a part of the Guiana coast, the nearly 2000 km of muddy and sandy shore of the Atlantic Ocean between the mouths of the Amazon and Orinoco rivers.

The coast of Surinam consists largely of vast tidal mud flats bordered on the higher parts by forests of black mangrove (*Avicennia germinans*). The flats alternate in space and time from an accretion to an erosion coast; the succession of accretion and erosion has a cyclic character. For a relatively small area along the Guyana coast, Diephuis (1966) established that such a cycle takes about 30 years. The rapid succession of accretion and erosion has resulted in a rather unstable shoreline. In a few places, the coast is fringed with a narrow sandy beach. In 1971, 66% of Surinam's 350 km shoreline was in accretion, 24% was in erosion, 4% was stationary, while 6% was fringed with a sandy beach (P. A. Teunissen, pers. comm.).

The mud deposited along the Surinam coast originates from the Amazon. This river yearly discharges large amounts of fine sediments into the Atlantic Ocean, which are transported along the Guiana coasts by the Guiana Current. There the silt is deposited as a watery sediment, called "sling mud" (Diephuis 1966). These depositions result in the development of the tidal flats mentioned above. During exposure, the flats contain much water, and as a result, are very soft. In general, it is impossible for men to walk on them without sinking in. The flats are very rich in tanaids (Tanaidacea, Crustacea) and, during exposure, constitute a very important feeding habitat for North American waders.

Along the erosion parts of the coast, the littoral zone consists mostly of a narrow, firm, and tough bank of clay layers eroding from older deposits. Like the narrow sandy beaches, these clay banks are less attractive for waders, having a much lower bird density than the tidal flats.

Landward, the coastal fringe is bordered by a wide zone of shallow lagoons and of brackish herbaceous swamps, broken by several low and narrow, wooded sand or shell ridges lying parallel to the coast. The large complexes of lagoons also form an important feeding habitat for waders. The lagoons are former mangrove forests in which the *Avicennia* has died in situ after prolonged inundation by sea water. For many years, the trunks of the dead mangroves are a dominant feature of the lagoons. After some time, the bare mud bottom of the lagoons may be covered by an herbaceous vegetation of halophytes, predominately saltwort (*Batis maritima*) and sea purslane (*Sesuvium portulacastrum*). Some lagoons have an extensive underwater vegetation of wigeon grass (*Ruppia maritima*).

FIG. 1. Map of the coastal area of Surinam showing the names of places mentioned in the text.

The water level in the lagoons and the feeding possibilities for waders are highly variable depending on the amount of precipitation, the frequency of inundation by the sea, and the amount of evaporation. The brackish herbaceous swamps found behind the belt of mangroves are mainly covered by the spike rush (*Eleocharis mutata*) and other Cyperaceae. During most of the year, the water level in these swamps is too high for waders. In the long dry season, however, there are extensive shallow and muddy areas, which attract large numbers of shorebirds.

Climate.—Surinam has a tropical climate; throughout the year, the mean daily temperature remains between 26° and 28°C. The amount of rainfall varies seasonally. Most rain falls in April to July (long rainy season) with the least rain in September to November (long dry season). Between November and April, there is a short rainy season (December and January) and a short dry season (February and March), both with a moderate mean monthly precipitation (Meteorologische Dienst 1965). There is, however, much variation in the onset of the seasons, both between coastal and inland localities, and between years. Table 1 shows the distribution of the monthly rainfall at the mouth of the Matapicakanaal for 1961–70 and 1970–73.

Data collection.—To obtain a picture of the fluctuations in bird numbers, I made 6 series of regular counts:

1. From April 1971 through April 1973, the numbers of birds present during low tide at a mud flat 10 km northwest of Paramaribo, locally known as "Weg naar Zee" (= road to the sea), were counted at approximately 2 week intervals for one or more days from a fixed point near the high tide water mark. The area surveyed had the shape of an isosceles triangle with the observer placed at the apex (18°) on the shoreline while the low tide water mark formed the base. At low tide, the flat extended about 1 km seaward (i.e. height of the isosceles triangle).

Table 1

Monthly Rainfall (mm) at Matapicakanaal

	Jan.	Febr.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1970	n.a.*	67	57	313	168	244	164	77	6	48	87	225
1971	252	179	134	130	550	149	161	n.a.	n.a.	n.a.	n.a.	83
1972	260	53	598	634	542	54	87	40	16	0	149	278
1973	2	27	11	67	197							
1961–70 (means)	182	96	100	138	252	225	131	64	11	28	40	169

* n.a. = not available.

Most counts were made late in the afternoon, when the sun interfered the least with observation. Occasionally, however, I made counts in the early morning. Counts were made with a 40 × 60 telescope. On most days, I made several counts between 1 h before and 1 h after low tide, from which I calculated the average numbers of birds present that day. These average numbers formed the starting point for further analyses.

2 and 3. From March 1971 through August 1972, I made counts at 2–4 week intervals in 2 lagoons near Krofajapasi, and from May 1971 through November 1972 in 2 lagoons near Motkreek. Both complexes of lagoons were situated just behind a sandy beach and received sea water during spring tides. On several counting-days during the long dry season, the lagoons near Krofajapasi were completely dry, with the result that many waders had gone to feed elsewhere. In contrast, on some days during the long rainy season, the water level was too high for most species of waders. The lagoons near Motkreek also had a highly variable water level, but since these lagoons were never completely dry, the fluctuations in bird numbers during the long dry season were less than in the lagoons near Krofajapasi. In the long rainy season, however, there were some counting-days with such a high water level that it must have had an unfavorable effect on the numbers of waders present.

The length of the route taken in the lagoons of Krofajapasi covered about .7 km, that in the lagoons near Motkreek about 3.5 km. The counts near Krofajapasi were made in the afternoon, those near Motkreek in the morning. Along both transects, waders were counted on both sides as far as they could be identified with certainty using 10 × 40 binoculars. At Krofajapasi, I also used a 40 × 60 telescope. As a result, the width of the area covered was not the same for each species, and thus interspecific comparisons could not be made.

4. From December 1970 through December 1971, at 2–4 week intervals, I counted waders around low tide along the nearly 8 km sandy beach east of Krofajapasi, locally known as "Bigi Santi" (= large beach). The counts were made between 06:00 and 09:00 (local time). This census included both the littoral zone, which was only some tens of meters wide, and the beach. The latter was mainly covered by ipomoea (*Ipomoea pes-caprae*) and sea bean (*Canavalia maritima*). During the long dry season, patches of the vegetation were burned. During the entire census period, the eastern end of the beach was fringed on the seaward side with a narrow, firm and tough eroding clay bank. During the first 9 months of the counting period, this bank was only a few hundred meters long, but after August 1971 it rapidly increased to 1.5 km. Since the bird density on the clay

bank differed from that on the sandy beach, the numbers of birds counted in these habitats will be given separately from September 1971 onward.

5. From March 1971 through October 1972, at Krofajapasi at 2–4 week intervals, I counted the numbers of Spotted Sandpipers (*Actitis macularia*) flying down the creek to their nightly roosts outside the mangrove swamps. Counts were made from about 17:00 until dark, which occurred between 18:20 and 19:00 depending on the time of the year.

6. From December 1970 through December 1971, Spotted Sandpipers were also counted along the nearly 6 km long Matapicakanaal. This canal runs through a former plantation area, now mainly covered by mangroves. The counts were made at various times of the day, and at various tide levels.

Presentation of the results.—The results of the censuses are given as mean numbers per counting-day in 10 or 15 day periods. The status of each species will be given by an estimate of the maximum number present at one day during the season(s) involved. These estimates have been obtained by extrapolation of the transect counts for the entire coast, adjusted by the percentages of suitable habitat. Considering the small number of transects counted and the small area of each habitat they covered, these estimates, of course, give only a very rough picture of the numbers of birds. As an index of abundance, the following scale has been used:

very large numbers—100,000 or more individuals
large numbers —50,000–100,000 individuals
rather large numbers—10,000–50,000 individuals
rather small numbers—2500–10,000 individuals
small numbers —500–2500 individuals
very small numbers—1–500 individuals.

Data on the status only refer to the numbers present in the coastal area landward up to and including the zone of brackish herbaceous swamps. For some species, therefore, the number of birds in Surinam may be higher than the numbers mentioned here.

RESULTS

In the following list, an account is given of the occurrence of the species which visit the Surinam coast yearly. For each species, data on the status, habitat selection, and numerical fluctuations will be given:

Black-bellied Plover (*Pluvialis squatarola*).—This species is present throughout the year in rather small numbers, possibly in rather large numbers. It can be observed everywhere along the coast, both on soft or hard mud, and on sandy substrates.

Numbers of any importance were counted in the transects of Bigi Santi and Krofajapasi only. In both transects, the species was present throughout the year. In neither of the transects, however, was a clear-cut seasonal trend observed.

American Golden Plover (*Pluvialis dominica*).—This species is a transient in very small numbers from September through November. It is mainly a bird of dry inland areas. Along the coast, I observed the species on the sandy beach of Bigi Santi in an area where the vegetation had recently been burned,

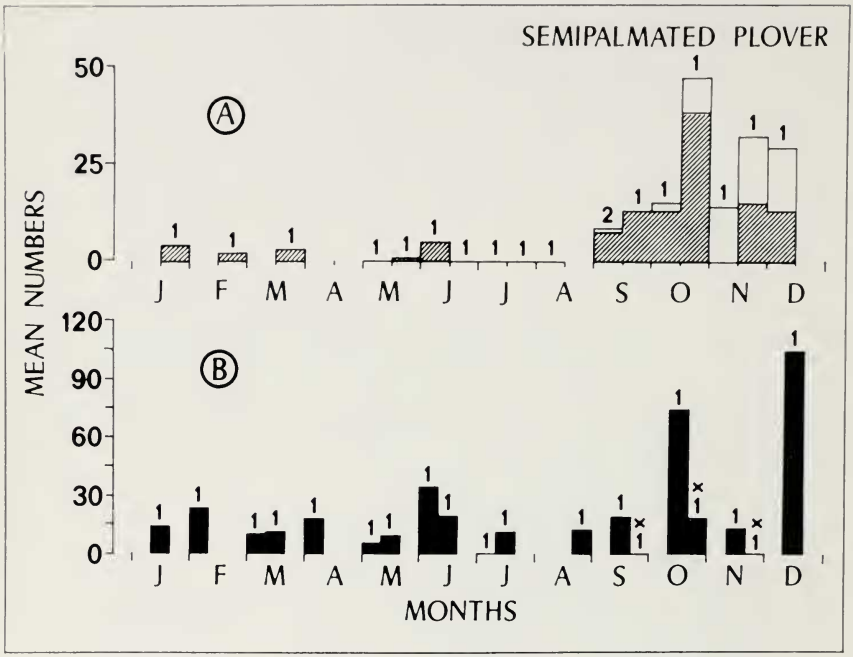

FIG. 2. Seasonal variations in numbers of Semipalmated Plovers along the Surinam coast. A. Beach of Bigi Santi, January through December 1971. The numbers counted on the sandy beach are indicated by cross-hatching; those on the clay bank are unshaded. B. Lagoons near Krofajapasi, March 1971 through April 1972. A cross indicates that no water was in the lagoons. The numbers at the top of the columns show the numbers of counts on which each datum is based.

and in parts of the lagoons near Motkreek that had dried up, between 15 September (1 bird) and 17 November (3 birds). My observation dates match rather well the period of fall migration mentioned by Haverschmidt (1969). Until now, the latest date for a fall migrant was 8 November (Haverschmidt op. cit.).

Semipalmated Plover (*Charadrius semipalmatus*).—This species is present throughout the year in rather large numbers. It is mainly distributed along the coast where it shows a strong preference for tidal flats and muddy lagoons.

Data on numerical fluctuations are available for the beach of Bigi Santi and for the lagoons near Krofajapasi (Fig. 2). At Bigi Santi, the species was seen throughout the year, except for a period of 2 months from mid-June through August. A pronounced peak in numbers occurred during late fall and early winter. In the lagoons near Krofajapasi, the species was observed

throughout the year with the same peak during the fall and winter periods. After December, numbers fell rapidly, both at Bigi Santi and near Krofajapasi. Since the drop in numbers coincides with the onset of the short rainy season, and hence with an enlargement of feeding areas in the lagoons, I suggest that it reflects a dispersal of birds to other feeding areas rather than a departure from Surinam.

During the spring, numbers remained low with no peak representing the passing of spring migrants. However, a small increase in numbers occurred in June. Since the increase was also noticed in other lagoons of the Krofajapasi area, I suggest that it reflects the arrival of summer visitors, probably from the South, rather than a concentration of birds that did not migrate to the North.

Upland Sandpiper (*Bartramia longicauda*).—Along the coast, this species is a transient in very small numbers in September and an irregular winter visitor. There, I observed it mostly on the sandy beach where the vegetation was rather open or where it had recently been burned. My sightings occurred between 1 September (2 birds) and 19 February (1 bird). Observation dates all fall within the period mentioned by Haverschmidt (1966).

Whimbrel (*Numenius phaeopus*).—This species is present throughout the year in rather small numbers with highest numbers from August through October. It is confined to muddy substrates along the coast.

None of the transect counts showed significant numbers. The statement on status mentioned above is based on qualitative data from outside the transects.

Lesser Yellowlegs (*Tringa flavipes*).—This species is a transient and winter visitor in very large numbers from mid-July through early May and a summer visitor in small to rather small numbers. The species is one of the most abundant waders on the tidal flats and in the shallow lagoons and brackish herbaceous swamps. Further inland, it is also numerous on flooded ricefields.

Data on numerical fluctuations are available for the mud flat near Weg naar Zee and for the lagoons near Motkreek and Krofajapasi (Fig. 3). Near Weg naar Zee, numbers increased from late July through mid-August, after which they remained high until early April. Near Motkreek, an increase in numbers occurred from mid-July through early August, after which they remained high until early March. Numbers then decreased rapidly. Near Krofajapasi, a moderate increase in numbers was seen in mid-July, followed by a decrease in September and an absence until mid-December. This was probably a result of poor feeding conditions there. From December through February, numbers remained moderate, followed by a peak abundance during March.

It might appear from the above data that a mass arrival of southbound transients did not occur before August. This, however, is not true. Large

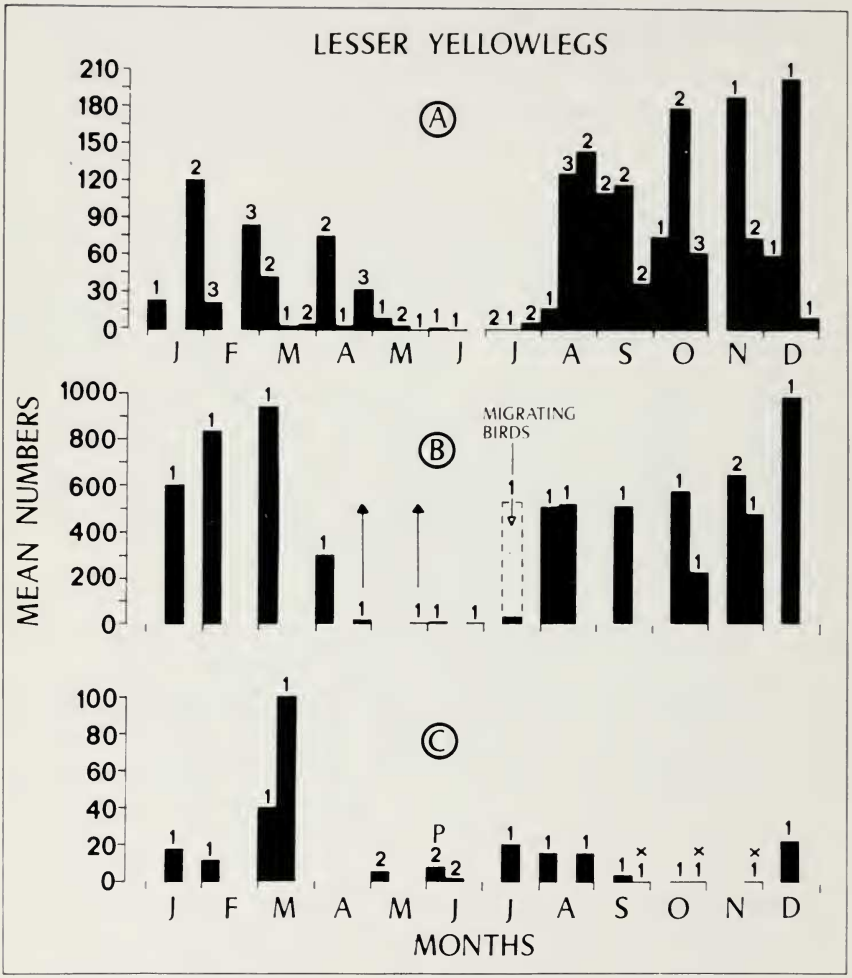

FIG. 3. Seasonal variations in numbers of Lesser Yellowlegs along the Surinam coast. A. Mud flat near Weg naar Zee, April 1971 through April 1973. B. Lagoons near Motkreek, October 1971 through November 1972. C. Lagoons near Krofajapasi, March 1971 through August 1972. An arrow indicates a very high water level in the lagoons. P indicates a partial count. Other conventions as in Fig. 2.

numbers arrive in July but evidently, few make a stop for any length of time. This was corroborated by observations of large numbers of Lesser Yellowlegs heading eastward along the coast in the second half of that month.

On the mud flat near Weg naar Zee the highest numbers occurred from August through December (long dry season) and in the lagoons near Motkreek

and Krofajapasi from December through March (short rainy season and short dry season). This indicates a shift from the mud flats to the lagoons with the onset of the rainy season.

The drop in numbers occurring after March near Motkreek and Krofajapasi suggests a mass departure from March onward. This was corroborated by observations of Lesser Yellowlegs departing the Motkreek lagoons on 10 March 1973. Data from mid-May through early July indicate that the species is a regular but not numerous summer visitor.

Greater Yellowlegs (*Tringa melanoleuca*).—This species is a transient in large numbers and a winter visitor in rather large numbers from mid-September through early May; it is a summer visitor in rather small numbers. Like the former, this species shows a strong preference for tidal flats and shallow lagoons; further inland, it is also common on flooded ricefields.

Data on numerical fluctuations are available for the mud flat near Weg naar Zee and for the lagoons near Motkreek (Fig. 4). The species was seen throughout the year in both transects with peak abundances during September–October (Weg naar Zee), in March (Weg naar Zee), and in April (Motkreek). The absence of a peak near Motkreek during the fall is somewhat puzzling. The peaks in fall and spring may coincide with the passage of southbound and northbound transients.

Solitary Sandpiper (*Tringa solitaria*).—This species is a transient and winter visitor in rather small numbers from late July through early May; it is possibly present in rather large numbers during the fall. Along the coast, this is mainly a bird of shallow lagoons and brackish herbaceous swamps; further inland, it is also a common visitor of freshwater pools and ditches, and of flooded ricefields.

I observed the species during the transect counts only occasionally. The statement on status mentioned above is based on qualitative data from outside the transects. My observations of a Solitary Sandpiper on 19 July 1972 and one on 9 May 1971 are the earliest and latest dates respectively, for this species in Surinam (see Haverschmidt 1968).

Spotted Sandpiper (*Actitis macularia*).—This species is a transient and winter visitor in rather large numbers from early July through early June; it is a summer visitor in very small, local numbers. The species is not confined to the coast and may be found everywhere that water is present. Along the coast, it shows a preference for shallow and muddy lagoons, but it may also be commonly found along creeks and canals, on firm and tough clay banks emerging from eroding coastline, and on higher parts of mud flats. During fall migration, it is also numerous on sandy beaches.

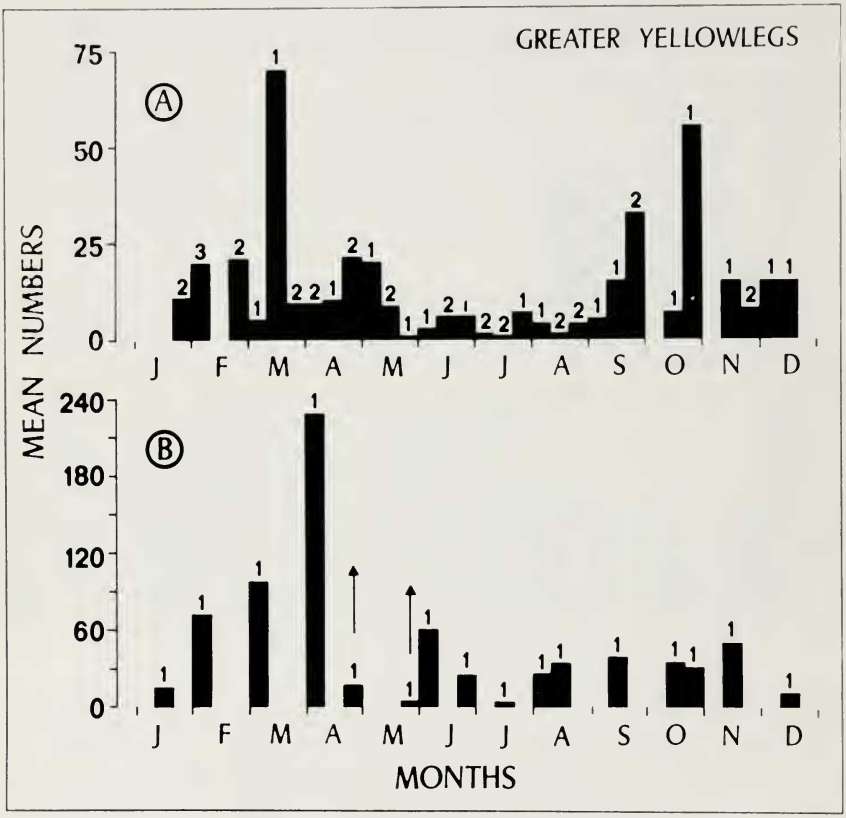

FIG. 4. Seasonal variations in numbers of Greater Yellowlegs along the Surinam coast. A. Mud flat near Weg naar Zee, April 1971 through April 1973. B. Lagoons near Motkreek, October 1971 through November 1972. Conventions as in Fig. 2 and 3.

Data on numerical fluctuations are available for Krofajapasi, Matapicakanaal and the beach of Bigi Santi (Fig. 5). The first fall migrants arrive during early July. The earliest dates, based on records from places where the species was absent in the weeks before, are: 2 July 1971 (2 birds), 5 July 1972 (8 birds; these birds must have arrived during the night since the species was still absent the day before at each place of observation), and 6 July 1970 (1 bird). After then numbers built up rapidly, reflecting a mass arrival of migrants. From August through May, the numbers of birds flying down Krofajapasi Creek fluctuated heavily; highest numbers were in January and lowest numbers were in September. Along the Matapicakanaal, the numbers remained high through January with much lower numbers occurring dur-

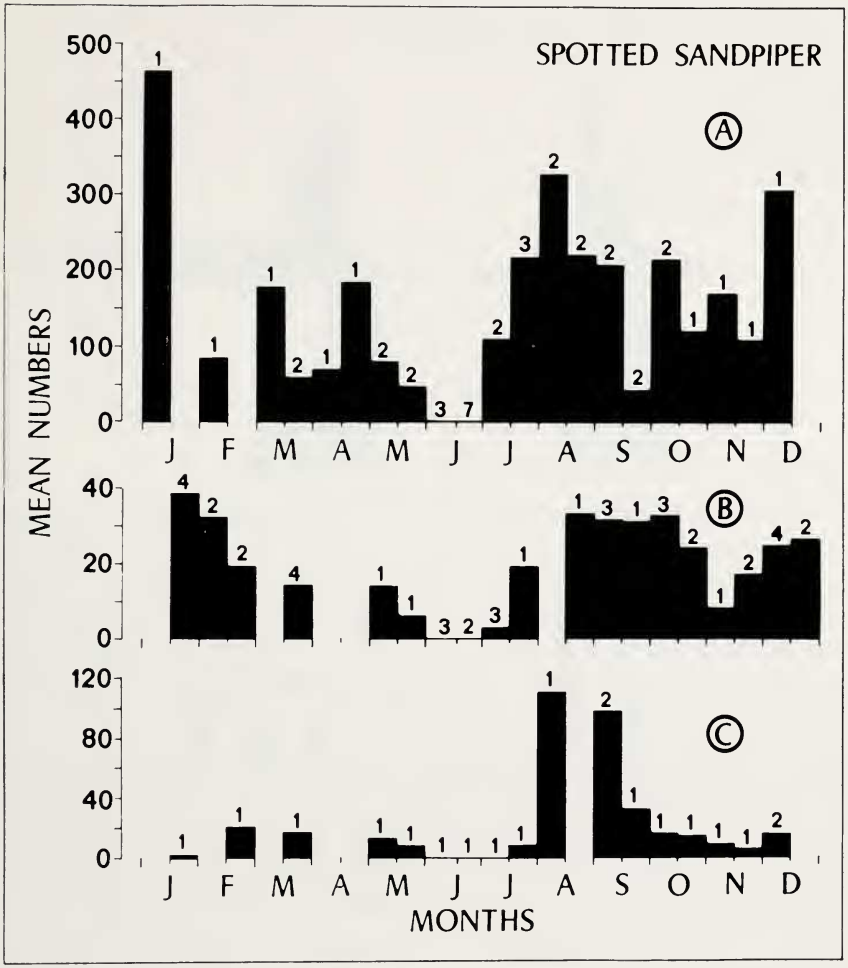

FIG. 5. Seasonal variations in numbers of Spotted Sandpipers along the Surinam coast. A. Krofajapasi Creek, March 1971 through October 1972. B. Matapicakanaal, December 1970 through December 1971. C. Beach of Bigi Santi, December 1970 through December 1971. Conventions as in Fig. 2.

ing the spring months. At Bigi Santi, numbers decreased sharply during September, indicating that the peak of fall transients passed through mainly in August and early September. During the spring months, no migration peak was observed in any of the transects.

During June, only few Spotted Sandpipers were seen, either in or outside the transects. Of my 14 observations (25 birds) in June, 8 (18 birds) were

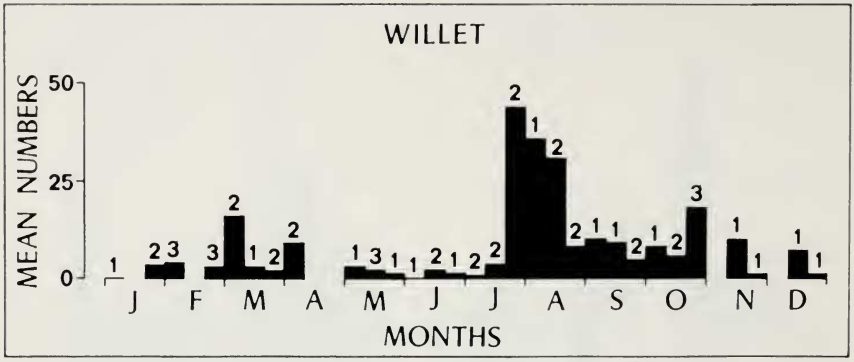

FIG. 6. Seasonal variations in numbers of Willets along the Surinam coast (mud flat near Weg naar Zee, May 1971 through April 1973). Conventions as in Fig. 2.

of birds flying down Krofajapasi Creek during the routine counts throughout the entire month. The other 6 records (7 birds) were from other places, and all fell in the first week of June. The latter, therefore, are likely to be late spring migrants rather than summer visitors. The data show, however, that near Krofajapasi Spotted Sandpipers were present during the whole month of June. I feel justified in considering these as summering birds. Only 2 June records have previously been reported (Haverschmidt 1968).

Willet (*Catoptrophorus semipalmatus*).—This species is a transient in rather large numbers, possibly in large numbers, from early July through mid-August; it is present during the other months in rather small numbers. The species is confined to the coast where it shows a strong preference for tidal flats. During the fall migration, however, large flocks may also be encountered in lagoons that have dried up.

Data on numerical fluctuations are only available for the mud flat near Weg naar Zee (Fig. 6). The species was seen here throughout the year with a peak abundance from late July through mid-August, after which the mean numbers fluctuated around a low level. In March (1973) and April (1972), the numbers counted were somewhat higher, perhaps reflecting the passage of small numbers of spring migrants.

From these data, it might appear that a mass arrival of southbound transients did not occur before the end of July, but this is not true. Elsewhere along the coast, the species was already numerous in mid-July. In 1972, I observed several flocks of 10–50 birds heading east at Eilanti as early as 4 July. Although peak numbers are over by late August, transients may pass until well into October.

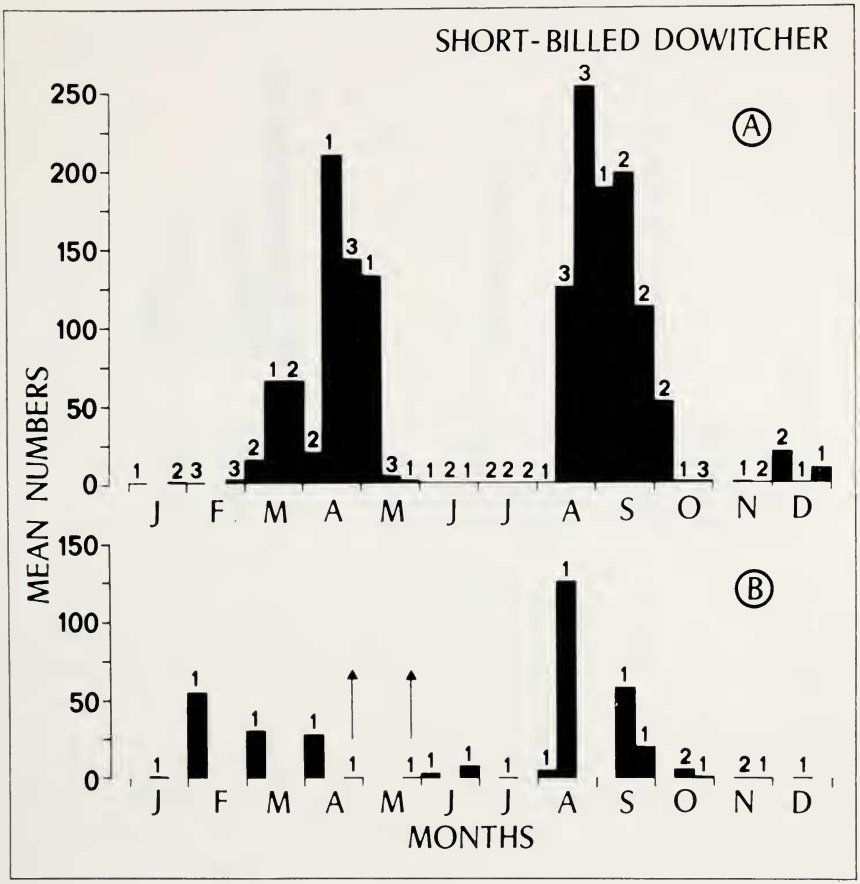

FIG. 7. Seasonal variations in numbers of Short-billed Dowitchers along the Surinam coast. A. Mud flat near Weg naar Zee, April 1971 through April 1973. B. Lagoons near Motkreek, September 1971 through November 1972. Conventions as in Figs. 2 and 3.

Ruddy Turnstone (*Arenaria interpres*).—This species is present throughout the year in rather large numbers. It can be found everywhere along the coastal shore where the substrate is firm.

Counts were made along the beach of Bigi Santi and in the lagoons near Krofajapasi. The numbers counted in these transects show no clear-cut seasonal trend, except for an increase during the fall and early winter on the clay bank at the eastern end of Bigi Santi coincident with an increase in the length of this bank. In neither of the two transects was there any indication of a migration peak in the northern spring. In both transects, rather fair numbers were present during the northern summer months.

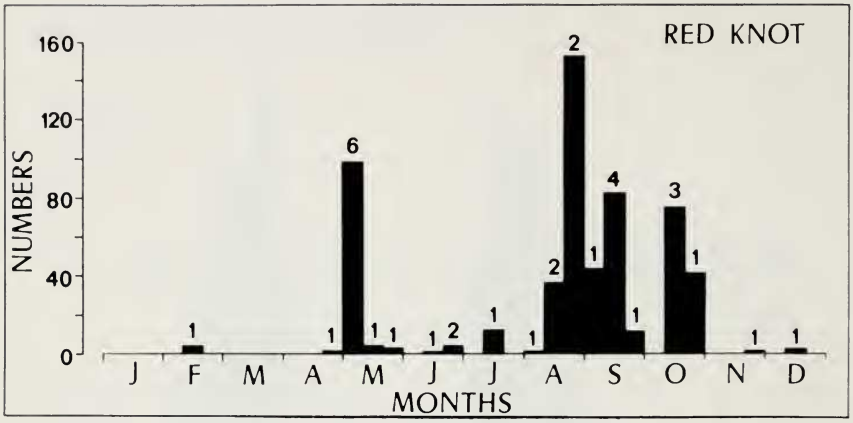

FIG. 8. Seasonal variations in numbers of Red Knots (pooled data) along the Surinam coast in 1970–73. Conventions as in Fig. 2.

Short-billed Dowitcher (*Limnodromus griseus*).—This species is a transient in very large numbers during the fall, from mid-August through early October, and during the spring, from early March through late May; it is a winter and summer visitor in small numbers. This species was found almost exclusively in lagoons and on tidal flats. On the latter, it showed a strong preference for the zone of sling mud near the low-water mark.

Data on numerical fluctuations are available for the mud flat near Weg naar Zee and for the lagoons near Motkreek (Fig. 7). Near Weg naar Zee, numbers were high from late summer through early fall and in the spring. Numbers were low during the northern winter, and the species was absent during the northern summer. Near Motkreek, highest numbers were seen in late summer and early fall, and lowest numbers were seen during the northern winter and summer. The low spring numbers probably resulted from high water levels during the long rainy season.

Red Knot (*Calidris canutus*).—This species is a transient in small numbers from mid-August through late October and in early May; it is a summer and winter visitor in very small numbers. Most Red Knots were observed on firm and tough clay banks emerging from eroding coastline and in shallow lagoons. I never observed the species on the soft tidal flats.

Since the species was not observed frequently in any of the transects all observations of knots along the coast have been lumped to obtain an idea about its occurrence (Fig. 8). The species was seen throughout the year with peaks from August through October, and in May.

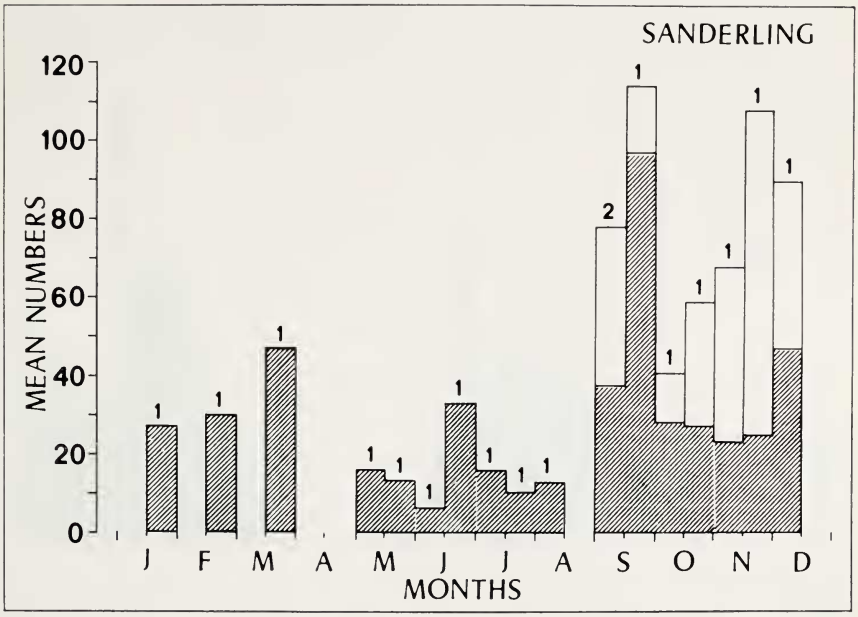

FIG. 9. Seasonal variations in numbers of Sanderlings along the Surinam coast (beach of Bigi Santi, January through December 1971). Conventions as in Fig. 2.

Sanderling (*Calidris alba*).—This species is a transient and winter visitor in small, possibly in rather small numbers, with highest numbers in fall; it is a summer visitor in very small numbers. The species, confined to the coast, was almost exclusively found on sandy beaches and on firm and tough clay banks emerging from eroding coastline.

Data on numerical fluctuations are available only for the beach of Bigi Santi (Fig. 9). The species was seen throughout the year with highest numbers from September through December. On an average, the lowest numbers were seen from May through August, but in one census (17 June 1971) 33 birds were counted—almost as many as the average number during the first three months of the year. In September, there was an increase in numbers on the sandy beach. Some tens of birds were also observed then on the clay bank fringing the shore at the eastern end of the beach, where the species had not been seen in the months before. On the sandy beach, numbers remained more or less constant throughout the rest of fall, except for a peak in the second half of September. However, on the clay bank, parallel to an increase in its length, numbers increased from October onward. A pronounced migration peak in spring was not observed, but it should be noted that no data were available for April.

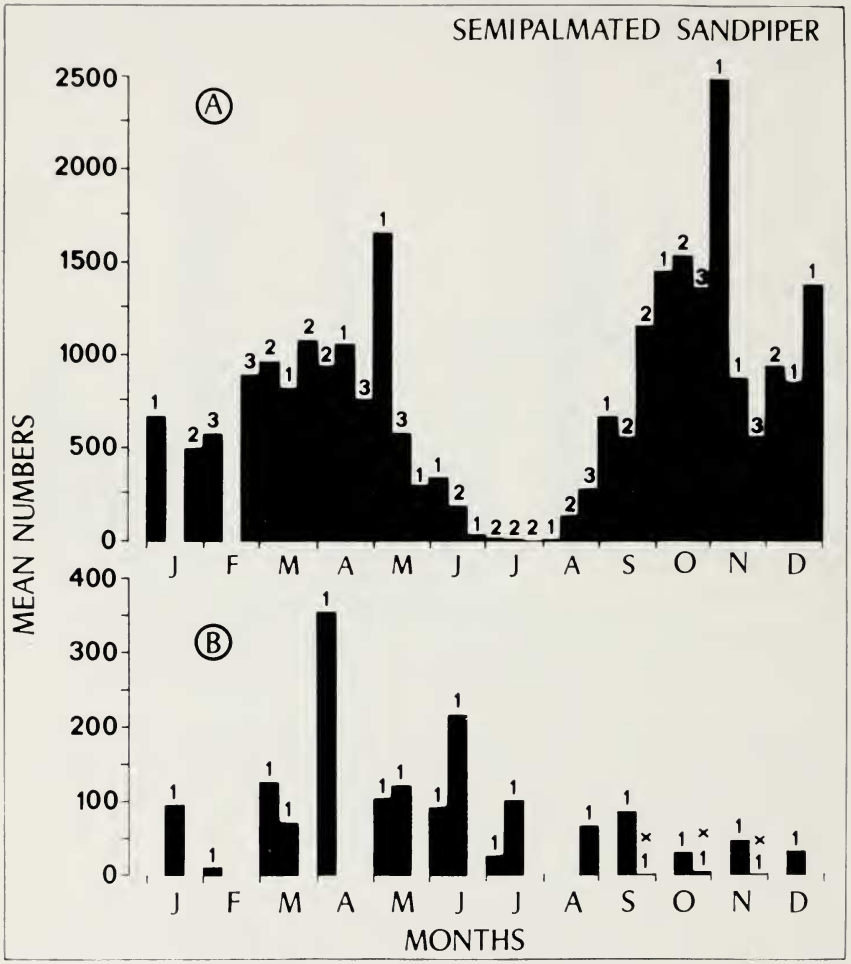

FIG. 10. Seasonal variations in numbers of Semipalmated Sandpipers along the Surinam coast. A. Mud flat near Weg naar Zee, April 1971 through April 1973. B. Lagoons near Krofajapasi, March 1971 through April 1972. Conventions as in Fig. 2.

Semipalmated Sandpiper (*Calidris pusilla*).—This species is a transient and winter visitor in very large numbers from mid-August through mid-June, and a summer visitor in rather large numbers, possibly in large numbers. The species is mainly confined to the coast, where it shows a strong preference for tidal flats and shallow lagoons.

Data on numerical fluctuations are available for the mud flat near Weg naar Zee and for the lagoons near Krofajapasi (Fig. 10). Numbers near

Weg naar Zee increased gradually starting about mid-August with peak abundance in early November, after which they decreased. During the northern winter, numbers fluctuated heavily with fewer present in January and February than in December. From late February onward, numbers were somewhat higher, with a small peak in early May. After this, numbers decreased to the low summer level.

Near Krofajapasi, no increase in numbers was observed after the onset of the fall migration. This was probably due to poor feeding possibilities there during the long dry season. After the onset of rains in January 1972, numbers were higher with peak abundance in April. Relatively high numbers were also present in June and July, when numbers near Weg naar Zee were at their lowest. This suggests that summering birds may concentrate at certain localities, which was corroborated by observations of large numbers elsewhere along the coast. For example, 30 June 1971, at least 12,000 Semipalmated Sandpipers were present on the tidal flats east of the mouth of the Coppename River, while in early July 1972, several thousand were present on the flats near Eilanti.

Western Sandpiper (*Calidris mauri*).—This species is a winter visitor in small numbers, possibly in rather small numbers, and probably a summer visitor in very small numbers. The Western Sandpiper is confined to the coast, where it frequents tidal flats and shallow lagoons. In western Surinam, they are probably more numerous than near Paramaribo. During 1970–73, around high tides, we caught only 2 *C. mauri* against nearly 3700 *C. pusilla* in the mangrove swamps near Weg naar Zee. In Nickerie, in the west of the country, however, Mr. W. E. van der Schot (pers. comm.) found at least 8 *C. mauri* (of which several are now in the Zoological Museum, Amsterdam) among 54 "peeps" shot by a hunter on 12 November 1972.

Least Sandpiper (*Calidris minutilla*).—This species is a transient and winter visitor in large numbers from mid-July through mid-June, and a summer visitor in small, local numbers. Along the coast, the species shows a preference for muddy lagoons and brackish herbaceous swamps. As far as I know, it avoids the exposed areas of the tidal flats but is rather numerous on open sites in the mangrove forests. The species is not restricted to the coast; further inland, it is a common species along ditches, in freshwater swamps, and in flooded ricefields.

Fig. 11 shows the numerical fluctuations in the lagoons near Motkreek and Krofajapasi. Near Motkreek, numbers increased during mid-July. From early August through early May, the species was present in fluctuating numbers with peak abundances in mid-August, early February, and early May. From late May through late June, the species was not observed in this transect.

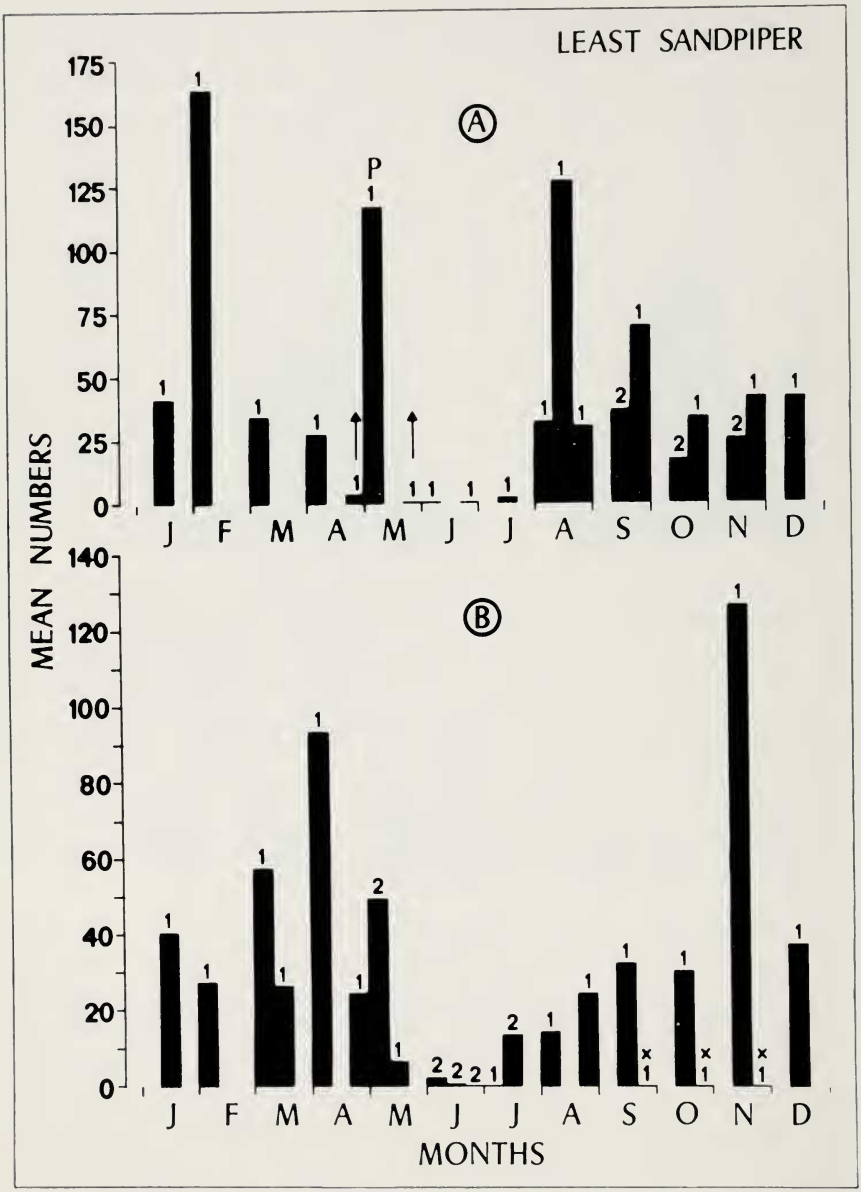

FIG. 11. Seasonal variations in numbers of Least Sandpipers along the Surinam coast. A. Lagoons near Motkreek, May 1971 through November 1972. B. Lagoons near Krofajapasi, March 1971 through August 1972. Conventions as in Figs. 2 and 3.

Near Krofajapasi, numbers increased gradually from mid-July through September, after which numbers fluctuated heavily with peaks in mid-November and early April. After early May, numbers decreased, but the species was present through mid-June. In late June and early July, no Least Sandpipers were observed in this transect.

Since the peak abundances were found in different periods of the year for the two complexes of lagoons, I suggest that they reflect fluctuations in feeding opportunities in the lagoons rather than differences in abundance as a result of arrival or departure of transient birds. In both transects, no birds were observed between departure of the last spring migrants and arrival of the first fall migrants. In this period, however, the species was observed regularly near Krofajapasi outside the transects. In the second half of June and first half of July 1971 and 1972, on five different dates, a total of at least 74 Least Sandpipers was observed. From these observations it may be concluded that at least locally, the species stays over during the northern summer. Summer records have not been reported previously (Haverschmidt 1968, pers. comm.).

White-rumped Sandpiper (*Calidris fuscicollis*).—This species is a transient in rather large numbers from mid-August through late November and in rather small numbers from early April through mid-June; it is probably an irregular winter visitor in small or very small numbers. The species was observed almost exclusively in lagoons and brackish herbaceous swamps. As far as I know, it avoids the lower zones of tidal flats. It may occur occasionally, however, in the higher zones of the littoral. The species also occurs further inland along freshwater pools and ditches.

Fig. 12 shows the seasonal variations in numbers in the lagoons near Motkreek and Krofajapasi. There was a mass arrival during late August (earliest date, 20 August 1972) and large numbers were also encountered in September. In October and November, however, only small numbers were seen. Most fall transients therefore pass through Surinam during the last ten days of August and in September. This is corroborated by a strong easterly migration parallel to the coast during these months (e.g. 31 August 1971, when, between 09:30 and 10:30, 688 birds in 61 flocks were observed near Motkreek flying low over the ground in an easterly direction). My latest fall observation date for this species is 28 November 1971. During the spring there was a low peak in May with the first birds arriving in early April (earliest date, 8 April 1972); the last birds departed mid-June (latest date, 21 June 1972).

Fall migration started much earlier and spring migration was extended much longer than mentioned by Haverschmidt (1968). Although I was on the

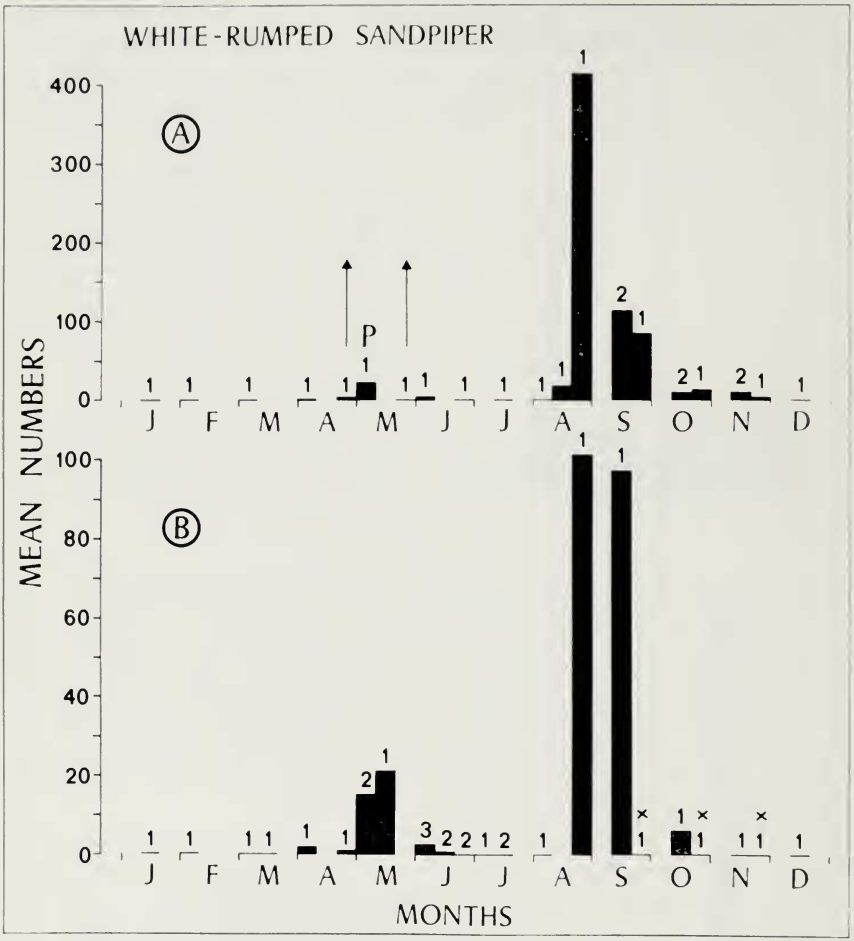

FIG. 12. Seasonal variations in numbers of White-rumped Sandpipers along the Surinam coast. A. Lagoons near Motkreek, May 1971 through November 1972. B. Lagoons near Krofajapasi, March 1971 through August 1972. Conventions as in Figs. 2 and 3.

look-out for wintering and summering birds, I did not locate any. Mr. F. Haverschmidt (*in litt.*) told me, however, that he observed the species several times in the swamps near Maasstroom in December 1963 and February 1964, suggesting that in some years the species may stay over during the northern winter.

Pectoral Sandpiper (*Calidris melanotos*).—In Surinam, this is more a bird of inland than of coastal habitats. Along the coast, I observed the species

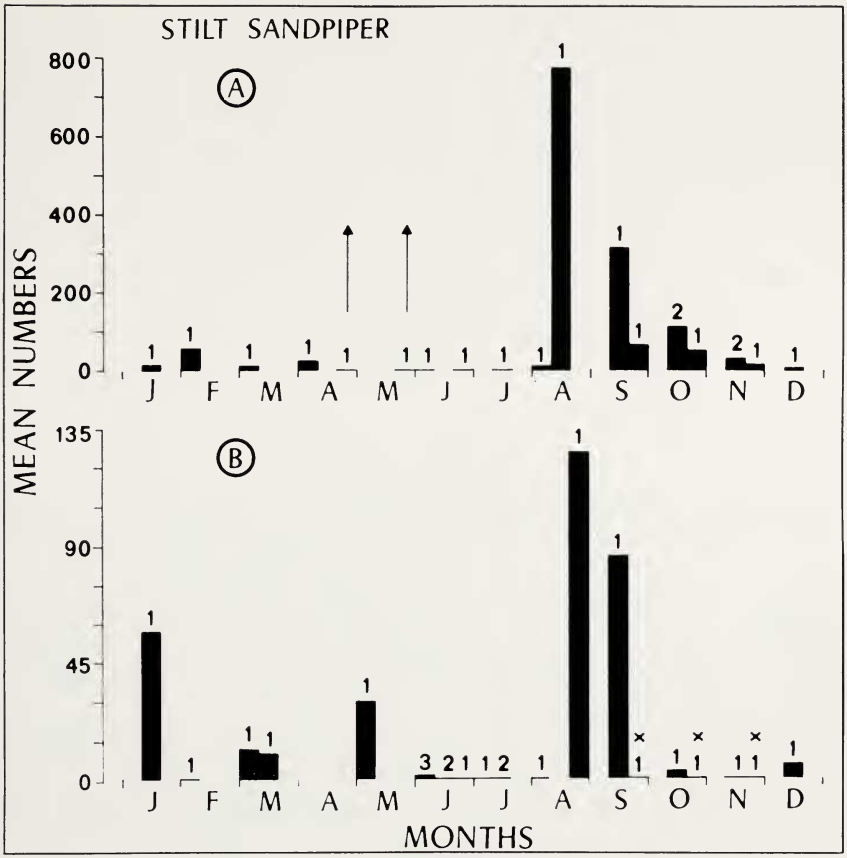

FIG. 13. Seasonal variations in numbers of Stilt Sandpipers along the Surinam coast. A. Lagoons near Motkreek, September 1971 through November 1972. B. Lagoons near Krofajapasi, March 1971 through August 1972. Conventions as in Figs. 2 and 3.

occasionally in shallow lagoons. It is probably more numerous in the brackish herbaceous swamps, and as far as I know, it avoids the tidal flats. Because of its scarce occurrence along the coast, I am not able to add new facts about its stay in Surinam (see Haverschmidt 1968).

Stilt Sandpiper (*Micropalama himantopus*).—This species is a fall transient in rather large numbers and a winter visitor in rather small numbers from early August through mid-May; it is probably a summer visitor in small or very small numbers. The species is confined to shallow lagoons and brackish herbaceous swamps. I have no observations of this species from the tidal flats.

Fig. 13 shows the fluctuations in Stilt Sandpiper numbers in the lagoons

near Motkreek and Krofajapasi. The first fall transients arrive during early August. The two transects respectively show peak abundance in mid-August and late August, reflecting a mass influx of southbound transients during this period. From September onward, numbers decreased in both complexes of lagoons, albeit more rapidly in the lagoons near Krofajapasi than in those near Motkreek. This difference possibly resulted from deteriorating feeding conditions in the former. During the northern winter and spring, the species was present in fluctuating numbers in both complexes of lagoons. No migration peak during the spring months was observed. The presence of large numbers of Stilt Sandpipers in nuptial plumage in the first half of May 1970 and 1971, indicates that spring departure continues until mid-May. During the northern breeding season Stilt Sandpipers were counted during early June only near Krofajapasi.

CONCLUSIONS AND DISCUSSION

Occurrence.—Of the 24 species and subspecies of North American waders known to visit the Surinam coast, 20 do so regularly. Most of these are present in Surinam throughout the year (Haverschmidt 1955, and 1968; and this paper). Exceptions are the American Golden Plover, Upland Sandpiper, Solitary Sandpiper, White-rumped Sandpiper, and the Pectoral Sandpiper, species for which no summer records are known. Records of the American Golden Plover are also lacking from the northern winter.

Of the 20 regular visitors, the Lesser Yellowlegs, Short-billed Dowitcher and the Semipalmated Sandpiper occurred during the study in very large numbers (maximum numbers present at one day estimated at >100,000), the Greater Yellowlegs, Least Sandpiper, and possibly the Willet in large numbers (maximum numbers 50,000–100,000), and the Semipalmated Plover, Spotted Sandpiper, Ruddy Turnstone, White-rumped Sandpiper, and the Stilt Sandpiper in rather large numbers (maximum numbers 10,000–50,000). The remaining species, except 2, occurred in maximum numbers lower than 10,000. The exceptions are the Black-bellied Plover and the Solitary Sandpiper, which were classified as occurring in rather small, possibly in rather large numbers.

Fall migration routes.—For several species the occurrence and abundance in fall differ to some extent from those in northeastern Venezuela as reported by McNeil (1970). In Surinam, peak numbers of the American Golden Plover, Willet, Short-billed Dowitcher, Red Knot, and the White-rumped Sandpiper are reached much earlier during the fall than they are in northeastern Venezuela. For the Red Knot and the White-rumped Sandpiper, peak numbers in Surinam are also much higher than in northeastern Venezuela. These data may indicate that these species reach Surinam from North America mainly through

a non-stop flight across the Atlantic Ocean. There is much circumstantial evidence that a non-stop flight across the Atlantic Ocean in late summer and fall is a common feature among waders. Radar studies along the coast of the Canadian Atlantic provinces (Richardson 1974), Massachusetts (Drury and Keith 1962, Nisbet 1963), and New Jersey (Swinebroad 1964) have shown that large numbers of North American waders on southbound migration move out to sea in ESE-SSE directions, ". . . as if on a non-stop flight to northern South-America" (Drury and Keith 1962). In addition, McNeil and Cadieux (1972) and Burton and McNeil (1975) working on southbound migrating waders at the Magdalen Islands in the Gulf of St. Lawrence and at Sable Island off Nova Scotia showed that many North American waders leave the Canadian Atlantic provinces with enough energy reserves to fly non-stop over the Atlantic Ocean to reach the Lesser Antilles and the northeastern coast of South America. Moreover, the regular occurrence of various species of North American waders at Bermuda in late summer and fall (Wingate *in* Drury and Keith 1962) also points to a transoceanic flight to South America, as do the recoveries of birds banded at the Magdalen Islands and at Sable Island (McNeil and Burton 1973, Burton and McNeil 1975).

The Greater Yellowlegs and the Semipalmated Sandpiper, on the other hand, reach their fall peak much later in Surinam than in northeastern Venezuela. For the Semipalmated Sandpiper, the Surinam peak follows a large departure of adults from Venezuela (McNeil 1970), which might indicate a relationship between counts in the two areas.

Spring migration routes.—In spring, too, some striking differences in occurrence and abundance were found between Surinam and northeastern Venezuela. In Surinam, a large spring migration peak was observed in the Short-billed Dowitcher and the Red Knot, and possibly also in the Greater Yellowlegs and the Willet, whereas in northeastern Venezuela none of these species showed a significant increase in numbers. In Venezuela, on the other hand, the Semipalmated Plover, Lesser Yellowlegs, Spotted Sandpiper, Ruddy Turnstone, Semipalmated Sandpiper, White-rumped Sandpiper, Stilt Sandpiper, and possibly the Least Sandpiper did show a clear spring migration peak, whereas in Surinam no migration peak, or only a very small one, was observed in these species.

On the basis of these data, I suggest that the spring migration route of Short-billed Dowitchers and Red Knots, and possibly also of Greater Yellowlegs and Willets, wintering south of the Guianas, is mainly to the Guiana coast, and from there non-stop across the Atlantic Ocean to North America. The latter suggestion is supported by observations of the departure of several flocks of Short-billed Dowitchers near Weg naar Zee in late April and early May 1971 and 1972, in directions varying between 332° and 351° (Spaans,

unpubl. data). The arrival of waders at Cape Cod, Massachusetts, in May from southeastern directions (Drury and Keith 1962, Nisbet 1963) also points to some transoceanic flights in spring.

Most other species, however, possibly take their spring migration route mainly across the South American continent by-passing the Guianas. Such a route is not unimaginable since many waders follow a route through the West Indies and the Mississippi Valley (Cooke 1912).

The reason for the differences in spring migration routes may lie with the geographical areas where the birds breed: a transoceanic flight for birds breeding in the most eastern parts of North America, and a route through the Caribbean and the Mississippi Valley for birds breeding in more western areas.

SUMMARY

During 1970–73, regular counts of North American waders were made along the Surinam coast to obtain quantitative data on their status and numerical fluctuations through the year. An extrapolation of these counts for the entire coast renders it likely that maximum numbers for the Lesser Yellowlegs, Short-billed Dowitcher, and the Semipalmated Sandpiper may amount to over 100,000, for the Greater Yellowlegs, Least Sandpiper, and possibly the Willet to 50–100,000, for the Semipalmated Plover, Spotted Sandpiper, Ruddy Turnstone, White-rumped Sandpiper, and the Stilt Sandpiper to 10–50,000. All other species, except the Black-bellied Plover and the Solitary Sandpiper, whose numbers may possibly amount to over 10,000, are less numerous.

Comparison of the data with counts from northeastern Venezuela suggests that in the fall many species reach the coast of Surinam through a non-stop flight across the Atlantic Ocean. In spring, many waders that spent the winter south of the Guianas seem to migrate across the South American continent, by-passing the Guianas. Only the Short-billed Dowitcher, the Red Knot, and possibly the Greater Yellowlegs and the Willet, mainly fly directly to the Guianas and from there non-stop across the Atlantic Ocean to North America.

ACKNOWLEDGMENTS

My thanks are due to Dr. J. P. Schulz, Surinam Forest Service, who has called attention to the need for ornithological research along the Surinam coast, to Professor M. F. Mörzer Bruijns, Department of Nature Conservation, Agricultural University, Wageningen, and Professor K. H. Voous, Free University, Amsterdam, for supervision of the study. The study was financed by the Netherlands Foundation for the Advancement of Tropical Research (WOTRO). The Surinam Forest Service provided boats and manpower to make possible the counts near Krofajapasi and surroundings, and to survey other rather inaccessible parts of the coast. My thanks are due to Mr. W. J. N. M. Verholt for drawing the figures, to Mr. H. A. Reichart for correcting the English text, and to Dr. D. G. Ainley and Dr. R. McNeil for their critical review of the manuscript. This paper was written while I held a temporary appointment at the Institute for Ecological Research, Arnhem, The Netherlands.

LITERATURE CITED

Burton, J. and R. McNeil. 1975. Les routes de migration automnale de treize espèces d'oiseaux de rivage Nord-Américains. Rev. Géogr. Montr. 29:305–334.

Cooke, W. W. 1912. Distribution and migration of North American shorebirds. U.S. Dept. Agric. Biol. Surv., Bull. 35, revised.

Diephuis, J. G. H. R. 1966. The Guiana coast. Tijdschr. Kon. Ned. Aardr. Gen. 83:145–152.

Drury, W. H. and J. A. Keith. 1962. Radar studies of songbird migration in coastal New England. Ibis 104:449–489.

Haverschmidt, F. 1955. North American shore birds in Surinam. Condor 57:366–368.

———. 1966. The migration and wintering of the Upland Plover in Surinam. Wilson Bull. 78:319–320.

———. 1968. Birds of Surinam. Oliver & Boyd, Edinburgh and London.

———. 1969. The migration of the American Golden Plover through Surinam. Wilson Bull. 81:210–211.

McNeil, R. 1970. Hivernage et estivage d'oiseaux aquatiques Nord-Américains dans le Nord-Est du Vénézuela (mue, accumulation de graisse, capacité de vol et routes de migration). L'oiseau et R.F.O. 40:185–302.

——— and J. Burton. 1973. Dispersal of some southbound migrating North American shorebirds away from the Magdalen Islands, Gulf of St. Lawrence, and Sable Island, Nova Scotia. Carib. J. Sci. 13:257–278.

——— and F. Cadieux. 1972. Fat content and flight-range capabilities of some adult spring and fall migrant North American shorebirds in relation to migration routes on the Atlantic coast. Nat. Can. 99:589–605.

Meteorologische Dienst. 1965. Climatological tables various elements Paramaribo. Period 1931–1960, monthly means. Serie 3. No. 2. Second edition.

Nisbet, I. C. T. 1963. Measurements with radar of the height of nocturnal migration over Cape Cod, Massachusetts. Bird-Banding 34:57–67.

Richardson, W. J. 1974. Spring migration over Puerto Rico and the Western Atlantic, a radar study. Ibis 116:172–193.

Swinebroad, J. 1964. The radar view of bird migration. Living Bird 3:65–74.

SURINAM FOREST SERVICE, PARAMARIBO, SURINAM, AND INSTITUTE FOR ECOLOGICAL RESEARCH, ARNHEM, THE NETHERLANDS. (MAILING ADDRESS: RESEARCH INSTITUTE FOR NATURE MANAGEMENT, KEMPERBERGERWEG 67, ARNHEM, THE NETHERLANDS). ACCEPTED 10 FEB. 1977.